UNITED STATES DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN

WASHINGTON, D. C. 787 DECEMBER 30, 1916

Contribution from the Bureau of Plant Industry, Wm. A. Taylor, Chief.

SEA ISLAND COTTON.[1]

By W. A. ORTON,

Pathologist in Charge of Cotton and Truck Disease Investigations.

CONTENTS.

INTRODUCTION.

Sea Island cotton is grown for its unusually long and silky fiber, which is used for making fine fabrics and laces. It is used also where great strength and durability are required, as in the manufacture of cloth for the best grades of automobile tires.

Sea Island cotton differs from the ordinary Upland cotton in many respects. The plant is taller, the leaves smoother and more deeply lobed, the flowers brighter yellow, the bolls smaller, longer, and more pointed, the seed nearly bare of fuzz, and the staple longer and finer. It is more closely related to Egyptian cotton, which it resembles in appearance.

As indicated by its botanical name, *Gossypium barbadense*, the original home of the plant is thought to have been the West Indies. When first introduced into the mainland of America, about 1786, it is reported to have been considerably different from the present form.

[1] This bulletin is a revision of Farmers' Bulletin 302, entitled "Sea Island cotton: Its culture, improvement, and diseases," issued in 1907. It is intended for distribution in Florida, southern Georgia, and the coast counties of South Carolina.

59436°—Bull. 787—16——1

The plant was a perennial—larger, later, and less productive than now. The method of culture described on page 15 was adopted to reduce the size of the plant and stimulate fruitfulness, but the great change that has been wrought is due mainly to careful breeding. Through several generations the planters have selected seed from the earliest, most compact, and most productive plants with the longest and finest staple, until the character of the plant has been radically changed.

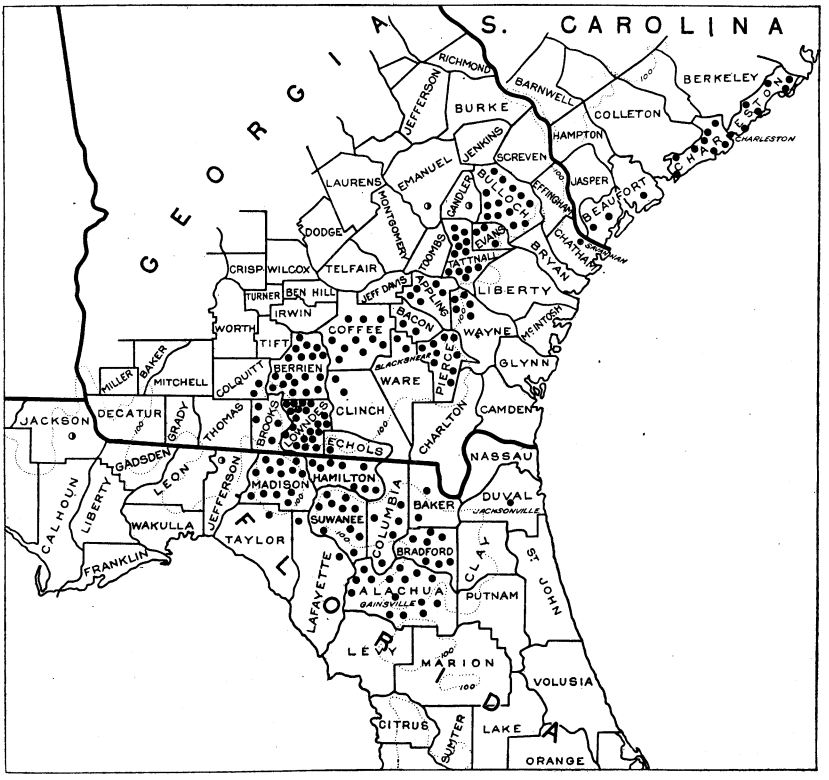

FIG. 1.—Map of the Sea Island cotton area of the United States, showing distribution by counties. Each dot represents an average production of 500 bales.

GEOGRAPHICAL DISTRIBUTION OF SEA ISLAND COTTON IN THE UNITED STATES.

The successful cultivation of Sea Island cotton in this country is confined to the area lying southeast of a line drawn from Georgetown, S. C., to a point in western Florida. The accompanying map, figure 1, shows the approximate quantity produced in each county in this district, each dot standing for 500 bales.

In South Carolina the center of production is on the Sea Islands along the coast, where the finest staples are grown. The chief of these islands are James, Edisto, John, and Wadmalaw.

It is interesting to learn that in Georgia the coast counties produce scarcely any cotton, owing to the unfavorable character of the country, the absence of the necessary labor, and the predominance of the lumbering and trucking industries. The interior counties which grow Sea Island cotton extensively also produce a considerable quantity of Upland cotton.

In Florida a similar condition exists. Cotton is not grown on the coast, but is confined to the interior counties in the north-central portion of the State. Here the proportion of Upland to Sea Island cotton is much smaller until one reaches the western counties, where conditions are less favorable for the long-staple cotton and where the Upland type is mainly grown.

The annual crop fluctuates widely, according to the nature of the season, but the average yield in bales of not quite 400 pounds each during the five years from 1910 to 1914 has been as follows: South Carolina, 8,022 bales; Georgia, 50,055 bales; and Florida, 30,454 bales.

It is quality rather than quantity that gives economic importance to the Sea Island cotton industry, for the total annual production is less than 1 per cent of the American crop.

IDEAL CROP REQUIREMENTS.

Several factors must be considered when seeking a location for growing Sea Island cotton. Those mentioned here affect not only the yield but the quality of the staple, its color, and the percentage of lint to seed. The relative influence of the various factors is, however, not always determinable.

SOIL.

The crop requires a sandy or a sandy loam soil, preferably with a clay or compact sand subsoil about a foot below the surface. Most of the Sea Island cotton is grown on the soil type classified by the Bureau of Soils as Norfolk fine sand, with lesser areas of Norfolk sand, Norfolk sandy loam, and related types. On the Sea Islands, where a clay subsoil is rarely found, the growers seek to maintain a compacted layer beneath the plants by the tramping of stock during the year the land is resting. The interior growers prefer a clay subsoil, but sometimes plant cotton on quite deep sand, where the quality is satisfactory; the yield is smaller, however, in such cases.

MOISTURE.

A well-regulated water supply is the most important factor influencing Sea Island cotton. Thorough drainage is essential. On this account more and better cotton is grown on the slightly elevated margins of the Sea Islands than in the lower central portions. Tile drains make possible the cultivation of land otherwise too wet. In the interior, cotton is grown only where there is suitable drainage.

On the other hand, a liberal and regular supply of water is needed, and wherever cotton is planted on the dry hills in the upper edge of the Sea Island cotton belt inferior results are secured, the staple becoming shorter and harsher. The lower lying lands are better, provided they have adequate drainage.

HUMUS.

Soils very rich in humus appear to be unsuited to Sea Island cotton, producing too rank a growth; but a deficiency of humus is also a serious objection, as such land produces a small plant with a tendency to the shedding of bolls and to rust.

LOCATION AND EXPOSURE.

Atmospheric humidity appears to be a prominent factor influencing the quality of the staple. On the Sea Islands, fields having an ocean exposure are said to produce a finer and glossier staple on account of the moisture-laden ocean breezes, and in the interior one advantage of the lower lands is doubtless their moist air, which is conserved by protecting forests and near-by swamps. In the absence of sufficient moisture in the air the staple becomes harsh and shorter. This is further shown by the fact that a wet season is more favorable to Sea Island than to Upland cotton, while the Upland varieties do better in a dry season. The relative production of Upland and Sea Island cotton in the northern counties fluctuates with the season and the changes in acreage due to varying market conditions.

The mixing of seed and the hybridization which result from planting cotton of both types in the same community are a serious handicap to the growers of Sea Island cotton. In this respect portions of Florida where only Sea Island cotton is grown possess a marked advantage, and the introduction of Upland varieties should be discouraged.

LABOR.

In addition to the effect of high prices in stimulating the industry and of low prices in depressing it, a factor which must be considered in connection with the production of cotton in either old or new sections is the supply of available labor. Until present methods are revolutionized a relatively large amount of fairly cheap labor is required, and it is a great advantage if the laborers have had long experience with the crop. Throughout the Sea Island cotton belt there is now a growing scarcity of labor, which is likely to restrict the acreage planted. The farmers must meet the new conditions by the adoption of labor-saving machinery in planting and in cultivation, but there will continue to be difficulty in getting the cotton picked.

The development of trucking and lumbering industries restricts the less profitable cotton crop, and there is a steady exodus of labor-

ers to engage in railroad building, etc., making the labor problem still more serious.

POSSIBLE EXTENSION OF THE SEA ISLAND COTTON-PRODUCING AREA.

There is little encouragement to offer to those who would attempt to introduce the culture of Sea Island cotton into other parts of the country than where it is now grown. Many such trials have been made during the past hundred years, and all have failed. Even in the present area the crop is losing rather than gaining ground in competition with Upland cotton, although the production of Sea Island cotton might be increased if market conditions warranted.

FIG. 2.—A bag of cotton on the Sea Islands ready for shipment.

Serious obstacles are met with in introducing Sea Island cotton into a new section. There is difficulty in securing the proper care in cultivation and in picking and handling the staple. Pickers accustomed to Upland varieties object so much to the small and partly closed Sea Island bolls that it is difficult to get the cotton picked even at the prices now paid—$1 to $1.25 a hundred pounds. The ginning must be done on a roller gin, as the saw gin injures the staple too much, and a specially equipped ginnery is therefore necessary. Further difficulties are met with in marketing the product, which at first can rarely be sold to advantage in a local market where the buyers are unaccustomed to the Sea Island staple. Shipment to a recognized market for Sea Island cotton is necessary in such cases.

MARKETS.

The cotton grown in South Carolina is marketed at Charleston, while the interior crop is handled at Savannah, Blackshear, and Valdosta, Ga., Alachua and Madison, Fla., and other interior towns. There is a marked difference in the style of bale in the two cases. South Carolina cotton is put up in bags, 7½ feet long and about 2½ feet in diameter, containing 300 to 400 pounds. (Fig. 2.) They

are filled by hand and pressed in a light hand-screw press. Compression for export is not practiced. As the use of this bag has been confined to the Sea Islands, it serves as a trade-mark to distinguish the crop in foreign markets.

In the Charleston district the finest cotton is that grown by a limited number of planters who have for many years paid the most careful attention to seed selection. Their cotton is not only long and fine but is picked with so much regard to cleanliness and uniformity that the grower's private brand on the package is often a sufficient guaranty of its quality.

These fine "crop lots" comprise about 35 per cent of the cotton marketed in Charleston and sell for from 30 to 60 cents a pound. They are all exported. The demand for this extra-fine and high-priced cotton is very limited. The remainder of the South Carolina crop is sold in the usual manner at lower prices. The higher price secured for South Carolina cotton is largely because of its superior preparation, all stained and weak cotton and bits of leaf being removed before baling.

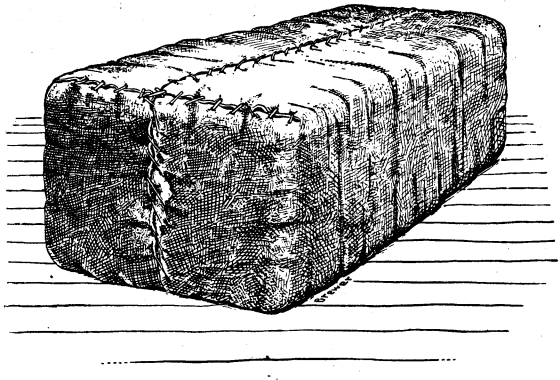

FIG. 3.—A bale of Sea Island cotton in the interior cotton region ready for shipment.

Interior Sea Island cotton is packed by a steam press into bales weighing about 400 pounds each, of the same shape and size as an Upland cotton bale, 54 by 27 inches. (Fig. 3.) They are covered with heavy burlap, secured by sewing with strong cord instead of by the steel ties used on bales of Upland cotton.

The buyers classify interior cotton first by length of staple, but little or no distinction is now made as to whether the cotton comes from Georgia or Florida, provided the body, staple, and grade are satisfactory. The length of staple is mainly influenced by seed selection, but in part by the character of the soil. Each of these classes is subdivided into grades with reference to its preparation and appearance, the usual grades being fancy, extra choice, choice, extra fine, fine, and "dogs." The difference of 5 to 10 cents a pound between fancy and fine shows the possible gain to the farmer from careful preparation. Loss of grade is due to exposure to weather before picking, to storing or ginning when too wet, and especially to the presence of stained or yellow cotton and bits of leaf or other trash.

FACTORS GOVERNING PRICES.[1]

There is a fairly uniform demand for a few hundred bags of extra-fine cotton with staple of 2 inches and over, and, for what the market requires, a high price, 50 to 80 cents a pound, will be paid. A larger quantity of this long-staple cotton is difficult to sell at any price. For the medium grades ($1\frac{5}{8}$ inches to $1\frac{7}{8}$ inches) there is a liberal demand at prices determined by the law of supply and demand. The size of the crop in Georgia and Florida is the principal factor in establishing the price, but other long staples exercise considerable influence.

Sea Island cotton is only slightly affected by the fluctuations of short-staple Upland cotton, but the amount and quality of the long-staple Upland crop seriously affect the lower grades of Sea Island cotton. Staples less than $1\frac{5}{8}$ inches long sell well only in a year when the long-staple Upland crop is inferior. This long-staple Upland cotton is grown mainly in the Mississippi Valley, and as it can be produced at a less cost than Sea Island cotton, it is evident that the latter must not be permitted to become less than $1\frac{5}{8}$ inches in length, in order to avoid this competition.

The next quality of staple competing with Sea Island cotton is the Egyptian, which has become the dominating factor in the price for long-staple cotton. Of this, an amount equivalent to from 1 to $1\frac{1}{2}$ million 500-pound bales is produced every year in the Nile Valley, and the equivalent of from 115,000 to 230,000 such bales are annually imported into America. An average price is $19\frac{1}{2}$ cents a pound. Egyptian, while not as long and fine as Sea Island cotton, is very strong and free from waste, owing to careful preparation. Its waste in the process of manufacture is somewhat less than that for Sea Island cotton. Much of the Egyptian cotton is decidedly shorter than Sea Island cotton, but the Sakellaridis variety is in marked competition with Sea Island of $1\frac{5}{8}$-inch staple or less and will continue to be used by many mills in preference to the American cotton until the Sea Island growers improve their product.

The Egyptian, although closely related to Sea Island cotton, can not be grown in our Southeastern States on account of its susceptibility to the bacterial disease black-arm; but it has been successfully introduced into Arizona.

Sea Island cotton produced in the West Indies is equal to the average American product, and, indeed, competes with the Carolina Sea Island cotton rather than with the interior product. The industry in the British West Indies is comparatively new, having been developed mainly since 1902, and is as yet of small proportions; but

[1] For a recent discussion of this subject, see Meadows, W. R., Economic conditions in the Sea Island cotton industry, U. S. Dept. Agr. Bul. 146, 18 p. 1914.

the production there may increase. Dr. Francis Watts[1] gives the output of Sea Island cotton from the several British West Indian islands during the past five years as follows:

		Pounds.
Barbados		2,180,032
St. Vincent		2,110,613
Montserrat		1,715,773
Antigua		765,137
St. Kitts-Nevis:		
St. Kitts	1,806,284	
Nevis	1,249,875	
Anguilla	485,997	
		3,542,156
Virgin Islands		184,511
Total		10,498,222

Interior planters are advised not to aim to produce an extra-long cotton. South Carolina and the West Indies can excel in this, and the market for such cotton is very limited. Furthermore, the increase in length is obtained at a sacrifice in yield which cancels the profit. Rather let the interior grower select for a staple $1\frac{5}{8}$ inches long and for a vigorous and productive plant and avoid the planting of Upland cotton near Sea Island fields.

DEFECTS IN ECONOMIC CONDITIONS.

The cost of cotton production is greatly increased by the prevailing credit system, owing to the higher cost of supplies and the reduction of the farmers' ambition and efficiency. The change from credit to a cash system now going on is a great gain for good farming and should be encouraged.

The common practice of renting land for a share of the crop greatly hinders the adoption of improved methods. It means instead the continuous planting of cotton without attention to seed selection or soil improvement. When the owner can not operate his farm himself, he should retain strict oversight over the work done by his tenant and provide, through a written contract, for a specified system of rotation and seed selection.

If the period of rental were three or five years instead of one, there would be more incentive for the tenant to build up the soil. The owner who keeps his land in a high state of cultivation has no difficulty in securing the best class of tenants.

There is a tendency among cotton buyers to pay an average price for all grades of Sea Island cotton, especially in the smaller markets. This means that good cotton brings less than its value, and inferior or dirty cotton too much. This practice is an injustice to the farmer

[1] Watts, Francis, Cotton growing in the West Indies. *In* Agr. News [Barbados], v. 15, no. 364, p. 118. 1916.

who produces a superior article, and it tends to discourage him from selecting for quality. Unless buyers are willing to pay full value for the best cotton, farmers can not be expected to improve their seed in any respect except to secure larger yields per acre.

It is an advantage to the farmer who has a superior grade of cotton to secure competitive offers from large buyers before selling. In this direction much good can be done by farmers' organizations.

CULTIVATION OF SEA ISLAND COTTON.

ROTATION AND DIVERSIFICATION.

Although Sea Island cotton always has been grown on the one-crop plan even on the Sea Islands, there are many reasons why greater success can be had by making it a part of a system of diversified farming.

By rotation of crops several purposes are accomplished, as follows:

(1) The productive capacity of the land is increased and maintained. The cultivation of cowpeas, velvet beans, and other legumes adds to the soil large quantities of nitrogen drawn from the air, enabling the farmer to secure at slight expense an element which is the most costly part of purchased fertilizers.

The physical condition of the soil is improved, especially by the addition of humus or vegetable mold, whereas continued cultivation in cotton or corn rapidly exhausts the humus. The importance of humus can hardly be overestimated. A soil rich in organic matter is more easily cultivated than other soil. It suffers less from washing, because the water is absorbed, and because of this water-holding power it does not quickly become too wet, nor does it dry quickly; hence, injury from drought is lessened. A soil rich in organic matter is richer in the beneficial bacteria and other organisms that take part in rendering available to the plant the food hitherto locked up.

By rotation, crops with different fertility requirements are alternated so that the same elements are not drawn on so constantly. Cover crops which increase humus can succeed cultivated crops which exhaust it, and in the intervals of rotation any poisonous or injurious excretion from the roots of a crop is neutralized. Deep-rooted crops may be employed to bring up plant food from the subsoil and leave it at the surface when they decay, where it will be available for shallower rooted crops.

The test of successful farming is to produce large and profitable crops and at the same time to build up the fertility of the soil, making it each year more productive. Diversified farming permits this to be done; continuous cotton growing never will.

(2) A diversified cropping system places farm operations on a safer and more economical basis. Regular and continuous employment for labor is secured if crops are grown which require attention at different seasons. The danger of loss from unfavorable weather or glutted markets is much diminished when several crops are grown. It is particularly important that the growers of Sea Island cotton should begin at once to practice diversification in order to gain experience with other crops, because there is a possibility that the invasion of the boll weevil into the Eastern States may in a few years make Sea Island cotton an unprofitable crop. Much hardship will result unless other crops are established meantime.

(3) Rotation of crops is one of the most effective means of controlling weeds, insects, and plant diseases. Crab-grass, nut-grass, and other weeds troublesome in cotton fields are reduced in numbers by the shading and smothering effect of a heavy growth of cowpeas or velvet beans.

Most injurious insects and plant diseases attack only one kind of plant. The continuous culture of any crop affords ideal conditions for the multiplication of its pests, while rotation of crops results in their destruction from lack of food. For example, the nematode worm, causing the destructive root-knot of peaches, cotton, etc., is greatly increased by planting susceptible crops, but can be controlled by a succession of immune crops, such as corn, oats, velvet beans, or peanuts. For several cotton diseases, including anthracnose, boll-rot, and black-arm, rotation is advised as one of several preventive measures.

ROTATION SYSTEMS.

The term "rotation" implies a prearranged order of succession for the various crops cultivated. Every farmer should draw up a planting scheme for his farm, worked out with reference to the relation of each crop to the others. The details of this plan will differ in every case according to the number of crops and the acreage of each, but some general principles apply to all.

The crops in a rotation may be divided into two classes:

(1) Money crops, in the majority of cases Sea Island cotton or truck crops, from the sale of which the principal income is derived. These draw from the soil more than they add to it.

(2) Improvement crops, grown mainly to build up the soil. These are usually legumes, such as cowpeas, velvet beans, peanuts, or beggarweed. If fed to stock they will return a revenue and improve the soil as well.

The choice of a legume.—Cowpeas have always been the most popular and widely grown crop of this class. They have many advantages over the others—adaptability to poor land, ease of culture, the value of the peas as food for man or stock, excellence as a hay crop, etc. On the other hand, most varieties are open to the serious objection that they are very subject to root-knot and greatly increase this disease. On land infected by cotton wilt or black-root the loss is increased by the presence of root-knot. Fortunately, the Iron cowpea is immune to root-knot and can be used with safety. In fields where it is certain there is no root-knot any pea can be planted, but the trouble is that root-knot frequently appears where its presence was not suspected. As all Sea Island cotton lands are sandy and subject to infection by root-knot and wilt, it is urged that no other cowpea than the Iron or Brabham varieties be used in rotation with Sea Island cotton.

Velvet beans are a great addition to the resources of Sea Island cotton growers. They are entirely immune to root-knot and black-root and of much value in rotations for this reason. No other legume grown in the Sea Island cotton belt makes as much growth or adds as much vegetable matter and nitrogen to the soil. Velvet beans

afford excellent grazing for stock in late fall and winter, and should be grown much more than at present. Their long season of growth is a disadvantage when a catch crop is needed to follow potatoes or grain. The vines are so long that harvesting for hay is nearly impossible.

Peanuts, or ground peas, are also free from root-knot, and are especially useful as feed for hogs. They appear to be somewhat less effective as soil improvers than cowpeas.

Beggarweed is native to Florida and seeds itself whenever permitted to grow. It makes a valuable hay when cut at the beginning of the blooming season and does good service in enriching the soil. In the cotton field it must be kept under control by thorough cultivation or the seeds will become tangled in the cotton, but if allowed to spring up late in summer it will serve as a winter cover crop, to the great benefit of the land. The complete immunity of beggarweed to root-knot is an important point in its favor.

Resting land.—A practice common on the Sea Islands and in portions of Florida is to plant cotton alternately on half the farm, leaving the other half to grow up in grass and weeds. This is much better than continuous cotton planting, but is a defective system because the maximum capacity of the land is not obtained. It is better to grow a useful legume than coarse or obnoxious weeds, like fennel, coffeeweed, and sandspurs; or, if pasture is needed, rye may be sown between the cotton rows in the fall, grazed during the spring months, then plowed under and Iron[1] cowpeas sown for hay or for fall grazing. Thus, there may be substituted a 2-year rotation, which is perhaps the most practicable plan for the conditions now prevailing. The 2-year rotation in its simplest form is cotton on half the land and corn and Iron cowpeas on the other half, the cotton following the corn and peas each year. A better plan is to plant one-half of the land in cotton, one-fourth in corn and Iron cowpeas, and one-fourth in velvet beans, reversing the order so that velvet beans come on the same land once in four years, cotton twice, and corn and peas once. This is practically a 4-year rotation. If, after this has been repeated several times, the land becomes too rich in nitrogen, as indicated by an excessive growth of the cotton to weed, the velvet beans can be omitted for a year or two. Velvet beans or cowpeas in these rotations should be fertilized with about 200 pounds of acid phosphate and potash to the acre. No nitrogen is required.

A 3-year rotation is better than one of two years. The 3-year rotation for the first year might consist of rye, oats, or wheat for hay, followed by Iron cowpeas; second year, corn with Iron cowpeas; third year, cotton. Cut the corn when ripe and shred the stalks. Do

[1] Brabham cowpeas may be used instead of Iron, if preferred. No other available varieties are resistant to root-knot.

not waste time pulling fodder. Cut the peas for hay or pasture them. In early fall plow under the stubble and sow rye, oats, or wheat. This grain should be cut for hay just before it ripens and should be off in time to plant velvet beans, if they are preferred to cowpeas. The field should be grazed during the fall and the remaining litter plowed in early enough in the winter to decay before the cotton is planted. The advantage of the 3-year rotation is that it permits keeping more live stock and will consequently improve the land more rapidly.

FERTILIZERS FOR SEA ISLAND COTTON.

PRESENT PRACTICES.

The character of the fertilizers and the amounts used per acre by farmers in different parts of the Sea Island cotton belt vary between wide extremes. The practices on the Sea Islands are characterized by heavy applications of home-mixed fertilizers, differing considerably in composition according to the ideas of the various planters, but usually rich in potash. The need for humus is recognized and is supplied by growing cowpeas and by heavy applications of marsh mud, salt-water grass, and compost. Three typical examples follow: (1) Two hundred pounds of kainit, 200 pounds of acid phosphate, 400 pounds of cottonseed meal, 25 bushels of Sea Island cotton seed, 25 loads of marsh mud per acre; (2) 200 pounds of kainit, 200 pounds of acid phosphate, 200 pounds of lime, 1,000 pounds of Sea Island cotton seed per acre; (3) 300 pounds of kainit, 300 pounds of acid phosphate, 300 pounds of cottonseed meal per acre.

In Georgia and Florida, on the other hand, light applications predominate. Occasionally, however, a farmer goes to the other extreme and puts on 1,000 to 2,000 pounds of fertilizer per acre. A common practice is to use a complete fertilizer of the 2–8–2 grade,[1] applying 100 to 250 pounds per acre. Some planters, however, use only acid phosphate and potash, while others use nothing but kainit.

GENERAL PRINCIPLES GOVERNING THE USE OF FERTILIZERS.

The fertilizer question is too complex to discuss fully here. Farmers' Bulletin 44 contains detailed information on this subject, and will be sent free of charge to any person requesting it. A few general rules to be remembered are the following:

(1) The best results from the use of fertilizers can be had only when the soil has been put in first-class physical condition by deep plowing and the addition of vegetable matter.

(2) Stable manure and compost made on the farm are cheaper and far more effective and lasting than commercial fertilizers.

[1] This means that the fertilizer contains 2 per cent of ammonia, 8 per cent of phosphoric acid, and 2 per cent of potash.

(3) The market value of commercial fertilizers is based on the nitrogen, potassium, and phosphorus they contain. The farmer should buy only the quantity of each element that will give the most profit on his soil.

(4) The amount of each element required varies with the soil so much that two sides of the same field often require different fertilizing.

(5) The proper fertilizer formula can not be told from a chemical analysis of the soil or of the plant, but an opinion can be formed from the appearance of the crop and verified by field trials.

(6) More plant food can be purchased for a given sum in high-grade fertilizers than in low-grade brands. Buy the best and use less per acre.

EFFECT OF NITROGEN.

Sea Island cotton requires less nitrogen than most crops, especially on low or moist soils. All excess of this element stimulates vegetative development, resulting in tall, coarse, and relatively unproductive plants, with large dark-green leaves. A lack of nitrogen is shown when plants are small, with a light yellowish green cast of foliage.

The usual sources of nitrogen, or ammonia, are cottonseed meal, dried blood, tankage, fish scrap, nitrate of soda, and sulphate of ammonia. It is the most expensive ingredient of fertilizers, costing 16 to 18 cents per pound, as compared with 4 to 5 cents for potash [1] and phosphoric acid, and for that reason should be supplied mainly by rotation with legumes. The effect of cowpea or velvet-bean stubble plowed under at the Alabama Agricultural Experiment Station was to increase the next year's cotton crop 63 per cent, this figure being the average of four tests. In such cases it is often unnecessary to purchase nitrogen, except that it may be profitable to apply about 50 pounds of nitrate of soda before planting, to stimulate the young seedlings to rapid growth. When commercial fertilizers are relied on the nitrogen is best derived from cottonseed meal or other organic materials, such as tankage or dried blood, which become available more slowly and are most lasting in their effects than the quickly soluble nitrate of soda or sulphate of ammonia. An exception should be made in the case of land subject to the blue disease, as stable manure or other organic fertilizers, unless very thoroughly decayed, aggravate this trouble. (See p. 40.)

EFFECT OF POTASSIUM.

A liberal supply of potash is very important for Sea Island cotton, and farmers outside of the Sea Islands use too little of it. Potassium influences the formation of starches and sugars in the plant and appears to be indispensable for protein formation. A lack of it in the case of Sea Island cotton may lead to the appearance of so-called rust, a disease resulting from disordered nutrition. Fields or parts of fields known to be subject to rust should receive an additional

[1] See footnote on page 14.

application of potash in amounts varying in accordance with the severity of the disease (see page 39). Kainit is the most common source of potash, but as it contains only 12 per cent of potash it should be applied liberally. Muriate of potash containing 48 per cent of potash is more convenient, on account of its concentration, and is usually considered to be proportionately effective. Fifty pounds of muriate of potash per acre would thus be equivalent to 200 pounds of kainit.[1]

EFFECT OF PHOSPHORUS.

This element in the form of phosphoric-acid compounds is indispensable to the Sea Island cotton plant for its general development, and especially for the seed and lint. Most soils are deficient in phosphorus, which is therefore an important ingredient of fertilizers. Acid phosphate is the usual source, and on account of its low price forms an unduly large proportion of the average fertilizer.

LIME USUALLY UNNECESSARY.

With the exception of occasional applications of marl on the Sea Islands, lime is not used by cotton growers, and there is little evidence that it would be profitable.

THE BEST FORMULA.

From the foregoing it will be understood that no fertilizer formula can be given that will fit all cases. The following is suggested, subject to modifications as the conditions vary: Nitrogen, 3 per cent; acid phosphate, 8 per cent; potash, 4 per cent. A ton of fertilizer having approximately this composition could be made from acid phosphate, 1,050 pounds; cottonseed meal, 750 pounds; nitrate of soda, 62 pounds; muriate of potash, 138 pounds. The potash should be increased on land subject to rust, and the nitrogen increased or diminished according to the size of weeds the land will produce.

QUANTITY TO USE.

The aim may well be to apply the maximum quantity of fertilizer that will return a sure profit. This will vary according to circumstances and can be determined only by experiments made on each farm. Two hundred pounds per acre is too little in almost every case, and if more than 1,000 pounds per acre are applied some of the fertilizer is likely to be wasted, particularly on thin land. The better the soil in tilth and the richer in humus the more fertilizer can be used to advantage or with profit.

[1] While war prices prevail, growers are advised to omit potash, to use all available wood ashes, compost, stable manure, and green manure, and to practice deep plowing, constant cultivation, and thorough tillage.

METHODS OF APPLICATION.

Where less than 400 pounds of fertilizer per acre are used it is probably best to apply all in the drill at the time of planting. For larger quantities many farmers prefer to divide the application, putting part in at the time of planting and the remainder during cultivation in June.

PREPARATION OF THE LAND.

Thorough clearing of the land, including the removal of all stumps, is essential for the use of modern plows and cultivators. The next requirement is drainage. If the land is wet or subject to overflow, it must be drained. This can be done by open ditches, but tiles are better. Farmers' Bulletin 524, on this subject, will be sent upon request. Many planters on the Sea Islands have greatly increased the producing capacity of their fields by drainage and have also much reduced the danger of loss from excessive rains.

RIDGE CULTURE.

On the Sea Islands, cotton is invariably grown on ridges or beds 5 feet apart, as indicated in the accompanying diagram (fig. 4). The method of forming and handling these beds is briefly as follows: Beginning in January, the old stalks are broken down, the limbs and trash raked into the alleys, and the coarser litter burned. In February, cotton seed is strewn in the alleys at the rate of 1,000 pounds to the acre, and a compost of stable manure, pine straw, marsh grass, and other refuse applied to as much of the field as the quantity obtainable permits, giving preference to the poorer portions. With a 2-horse plow a furrow is turned in from each side to cover the compost and seed. In late February or in March, the commercial fertilizer is drilled in at the rate of 600 to 1,000 pounds per acre and covered. The beds are rolled with a double roller (fig. 5) before planting. Strips of wood on these rollers mark the position of the hills. Planting is usually done by hand, sometimes with a planter. When the cotton is well up it is cultivated with a sweep and hoed by hand, the dirt being drawn around the plant. Cultivations and hoeings alternate. The cotton is worked every week—eight to ten times in all. Thinning begins when the plants are 5 to 6 inches high and is done gradually until only one plant is left in a hill. The cotton is laid by in July or August, when it becomes too large to work without injury. The plants are then growing on broad beds separated by alleys about a foot deep.

FIG. 4.—Diagram showing the ridge method of culture practiced on the Sea Islands.

While level culture is generally practiced in Georgia and Florida at the present time, it is quite likely that a modification of the South

Carolina broad bed would be more profitable. This ridge system gives better results in two classes of cases, as follows:

(1) On low and poorly drained land, where it permits greater root development on account of the improved aeration of the soil.

(2) When, on account of the land being rich and well fertilized, Sea Island cotton grows too much to weed under level culture. In such cases the grower is compelled to adopt measures to turn the energies of the plant from vegetative growth to fruiting. This is done by restricting the root development, (1) by maintaining a compact subsoil, which the Sea Island planters accomplish on their deep sandy soils by pasturing with cattle during the year of rest; (2) by regulating the moisture supply by the high beds, and (3) by

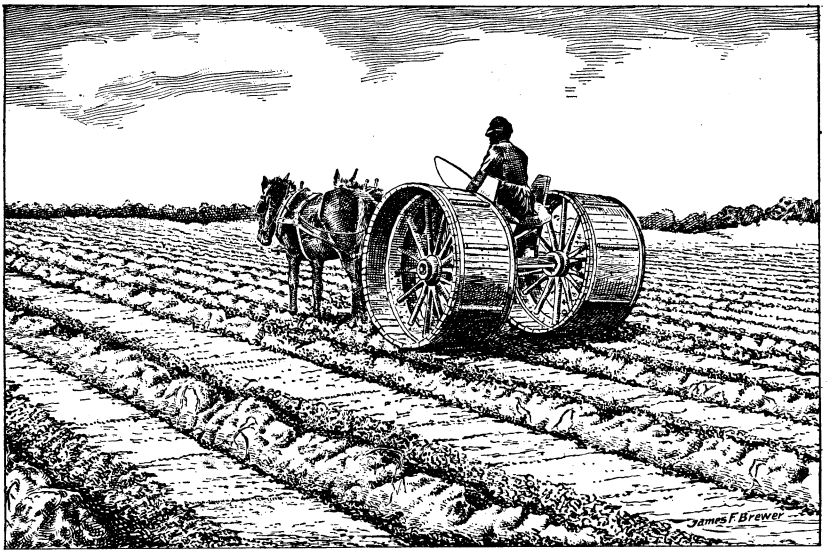

FIG. 5.—Double roller used on the Sea Islands, showing strips of wood used to mark the location of the hills.

root pruning by deep cultivation if the cotton needs it. It is also believed by the Sea Island planters that ridge culture permits better control of nut-grass, as this pest can be kept down more successfully by covering it with earth than by cutting it up.

The ridge system has its limitations and disadvantages, which must be borne in mind. It will not do for light and droughty soils deficient in vegetable matter and scantily fertilized, where the cotton plants would suffer from lack of moisture. Such soils should first be built up by a course of green manuring. The greatest disadvantage of the ridge system is the increased cost of cultivation due to the hand labor required to draw the earth around the plants. This objection can and must be met by the introduction of improved implements for cultivating which will work the beds without hand labor.

Interior farmers are advised to test the ridge method thoroughly after carefully studying the subject and adapting it to their conditions.

LEVEL CULTURE.

If level culture is preferred, the following instructions will apply.

PLOWING SHOULD BE DEEP.

It is advised that the land be broken broadcast with a 2-horse plow, 6 to 8 inches deep or as deep as practicable under the circumstances. In very shallow soils only an inch or so of the subsoil should be turned up at once, but by plowing an inch deeper each year such a soil can be deepened. Subsoiling has its advocates and may be profitable in some cases, but for the average Sea Island soil it is not recommended. If practiced at all, it should be for the corn or other crop preceding cotton in the rotation.

VEGETABLE MATTER SHOULD BE PLOWED IN.

All vegetable matter on the land and all that can be put on it should be plowed under in early winter, when it will have time to decay. The remains of a velvet-bean crop, or grass, weeds, cornstalks, etc., all greatly improve the land.

The common practice of burning over land before plowing can not be too strongly condemned. It means the deliberate destruction of fertility worth more than the farmer can afford to purchase and the loss of the humus that should be conserved by every possible means. An exception to this rule should be made if boll-rot or black-arm has been troublesome. Diseased stalks should be burned to prevent the infection of the next crop.

FERTILIZING AND BEDDING.

Having broken the land broadcast, apply the fertilizer with a fertilizer distributor in drills the proper distance apart. Bed over this with a disk harrow or with plows in the usual way.

PLANTING.

Plant with a good machine, preferably one that will drop the seed in hills at the desired distance, and thus save labor in chopping to a stand. A good distance for average conditions is 20 inches apart in 5-foot rows. The plants should finally be thinned to one in a hill. It is very difficult to judge the plants properly when selecting seed if two plants grow in the same hill.

Time of planting.—It is advised that planting be begun as early as the season permits. This varies in different years and sections from March 15 to April 10. Early-planted Sea Island cotton is found to make a more compact and fruitful plant, while late cotton tends to form a larger and coarser weed.

Long experience is required to judge truly the best time for planting, for the southern spring is variable and uncertain. On the one hand the cotton must escape frost, and on the other the spring droughts. Should dry weather prevail before planting is completed, the seed should not be put into the ground until there is ample moisture to bring it up, as otherwise it is likely to perish. Soon after the cotton comes up replant all missing hills. Every effort must be made to obtain a perfect stand. Every missing hill reduces the crop, while the cost of cultivation is the same as for a full stand.

CULTIVATION.

With level culture a weeder can be used to advantage for the first cultivation and at weekly intervals until the plants are too large. It must be used frequently, as it will not eradicate large weeds. Cultivation in general should be frequent and shallow. Cultivate deep only when the cotton is growing too fast and it is desired to stimulate fruiting. Economize labor by using cultivators rather than sweeps. Work the land as soon as dry enough after each rain, aiming to preserve a shallow dust mulch to conserve moisture. Never plow or cultivate when the land is wet. Lay by the cotton only when it is too large to cultivate without injury.

SEED SELECTION.

The high quality of Sea Island cotton to-day is due to the careful seed selection that has long been practiced on the Carolina Sea Islands. Seed selection is therefore a feature of prime importance, the keystone of the arch. The cotton plant has become variable, enabling the breeder to select finer forms and to raise the standard of the crop far above its natural level. By reason of this variability seed selection must be continued to prevent deterioration, for there is no standing still. The upward movement must be continued by perpetuating the finer types desired by the cultivator, or, if neglected, the inferior plants will increase rapidly in the crop and the cotton will tend to revert to its original type.

This constant seed selection is as necessary on the Sea Islands as in the interior.

SEA ISLAND METHODS.

There has been developed on the Sea Islands a well-defined and uniform system of selection. It is based on the correct idea—that of discovering the best individual plant and preserving its offspring. A number of superior plants are marked and carefully compared in the field, then picked separately and the seed cotton critically examined. The best plant is retained and the seeds planted in a plat by themselves, one or two in a hill, making perhaps 500 plants in all.

If this plat retains the good qualities of the parent plant, the cotton is picked and the seed again planted separately, making a 5-acre plat the third year. The fourth year there will be seed enough to plant the whole crop, all descended from the single stalk first chosen. A new individual plant is selected every year, so that a fresh supply of seed is always being grown. Seed from the general crop is considered less desirable for planting at home and was formerly sold to Georgia or Florida growers. A more effective method is to select and compare the progeny of several selections, as advised on page 22.

SEA ISLAND VARIETIES.

A number of planters on the Sea Islands have been practicing this system of seed selection for many years. Each man has his own ideals respecting the best form of plant and the most profitable length of staple and selects a type conforming most closely to this ideal. There have thus been developed a number of distinct varieties of Sea Island cotton which differ in length and quality of staple, form of plant, size and appearance of seed, percentage of lint, and other features. They are not given varietal names as much as in the case of other cultivated crops, but when offered for sale are known by the name of the breeder, as Hinson, Seabrook, Rivers, Sosnowski, etc. These names have not been preserved when seed has been sold to interior points, and there is consequently much confusion in the matter of varietal names.

Varieties of Sea Island cotton are constantly changing. Each breeder renews his stock annually and in doing so may propagate from a plant differing from his old type, in which case his entire crop four years hence would be influenced.

Breeders' rights.—Many of the Sea Island varieties, particularly the finer ones, are considered the personal property of the originator, who will not part with any of his seed, even to his neighbors. To do so would be likely to result in an overproduction of that particular staple and a lowering of prices, as the market demand for the higher priced staples is exceedingly limited. A strain of fine cotton is the product of many years of careful selection and could not be duplicated without long-continued work requiring much skill and care.

Sale of seed from the Sea Islands.—On the Sea Islands the growers of medium staples, for which there is a larger market than for the finer product, have for many years sold their seed, both at home and to buyers in Georgia, Florida, and foreign countries. In 1904, however, West Indian competition stimulated the formation of an association to prevent the sale of seed outside the Sea Islands. This embargo did not accomplish the desired aim, and the association has disbanded. It is greatly to be desired that the skilled breeders of the Carolina islands should select and grow for sale to the interior

growers strains of suitable staple, about 1⅛ inches, to meet their requirements. Georgia and Florida, which have always depended on Sea Island seed, produce 90 per cent of the American crop, but because of the total neglect of seed selection, deterioration has been rapid there, necessitating the renewal of seed every few years.

SEED SELECTION WILL SUCCEED IN THE INTERIOR.

Thrown on their own resources, the interior growers have found that they can grow their own seed and maintain a satisfactory quality. The success of the Carolina planters is due to their methods more than to their soil and climate. There are already men in Georgia and Florida who have maintained the quality of their cotton for 15 years or more by selection without renewal from the Sea Islands. In fact, it should be possible to produce a variety better fitted for interior conditions than any imported seed, for adaptation to climate and soil can be secured together with greater productiveness.

METHODS OF SELECTION.

The amount of gain from seed selection will depend mainly on the method employed; the more care taken, the better will be the results. If any farmer is so situated that he can not select his own seed, let him at least obtain seed for planting from the middle picking in a field of known good quality or purchase from some near-by seed breeder. He should not risk an entire season's labor by planting seed of unknown value taken at random from a public gin.

Three methods of selection will be described. Under varying circumstances, all of them may well be employed.

ROGUING.

The simplest method of selection is called "roguing," because it involves merely the removal of inferior or varying plants, called "rogues" by seedsmen. This practice will serve to lessen deterioration in a variety already of satisfactory quality, but will not effect any material improvement. Every grower of Sea Island cotton should destroy all hybrid and run-out stalks whenever observed. The hybrid plants are the results of crossing between Sea Island and Upland varieties, or between Sea Island and other hybrids. They are the tall stalks, often called "male stalks" or "bull cotton," which are quite common in the average interior field. They do harm in three ways: (1) On account of their great size and vigor, one of them takes up as much room in the field as two good plants; (2) they bear a scanty crop, which is so inferior that it reduces the price of the whole crop when detected in the sample; (3) every seed from one of these plants produces a hybrid plant the following year; and (4) they hybridize with near-by plants and thus cause rapid deterioration of the quality of the crop.

Run-out plants are Sea Island stalks which have deteriorated until the staple is short and too scanty to cover the seed. (Fig. 6.) They can not be detected until the bolls begin to open, when it is best to pull them out, as the crop they will bear has no value and only lowers the quality of the rest of the crop.

GENERAL SELECTION.

A simple method of improving seed is to pick from the best plants in the field enough to plant the next crop, or to select with still more care a smaller quantity to plant a seed plat of 3 or 4 acres to grow seed for the general planting the following year. The selection of

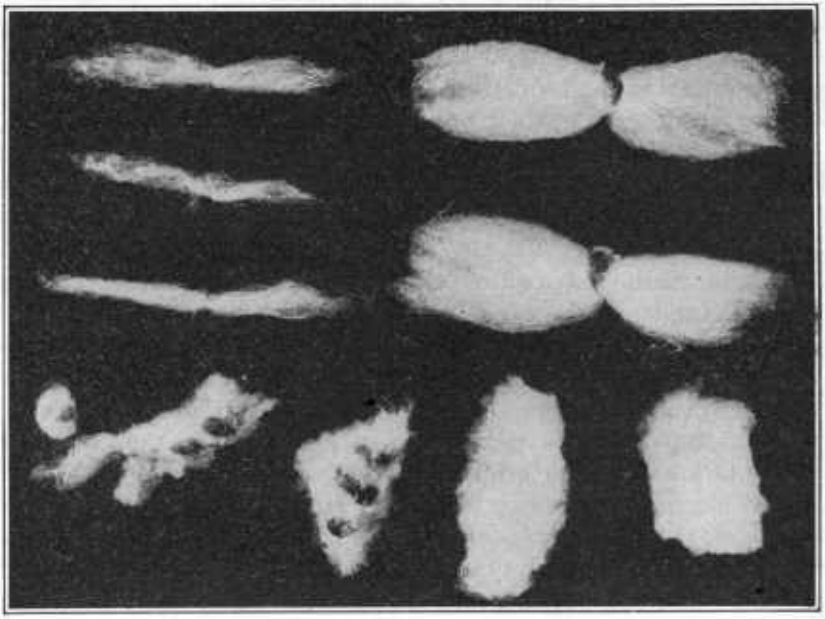

FIG. 6.—Good seed cotton (at the right) compared with a run-out form (at the left). The lower figures are the locks as picked. The upper figures are seeds with the fibers straightened out.

the seed is best done by the farmer himself, assisted by two careful pickers. Select from the middle picking before the main crop is gathered. Search through the whole field for the best and most productive plants. Before directing the pickers to pick a plant, examine the staple and reject every plant with lint less than 1⅛ inches long. It would be a vital error to select without regard for length of staple, because plants with wide-opening bolls would then be chosen and this quality is often accompanied by a short staple. Gin this selected cotton separately on a clean gin.

This method of selection can easily be followed by every farmer and will produce good results, but it is by no means as effective as the next plan described.

PEDIGREE BREEDING.

Pedigree breeding, while requiring more careful attention than the methods already described, will effect the greatest improvement in the least time and should be followed by all who undertake the production of improved seed for sale. It is substantially the same as the plan followed by the planters on the Carolina Sea Islands, where no other method would maintain such a high quality. All progressive farmers would profit by adopting this system.

The fundamental principle is to breed from a single plant of exceptional merit, which must also prove its ability to transmit its good qualities through its seed to its progeny. Instead of planting mixed seed taken from a large number of good plants, as in the preceding method, the choice is narrowed first to a few plants which are compared not only as to productiveness, length and quality of staple, etc., but also with regard to their prepotency and the uniformity of their offspring, as determined by a planting test the following year, until finally the progeny of the best individual is chosen. The seed thus obtained is increased as rapidly as possible until enough is secured to plant the whole crop.

A similar method is practiced by successful breeders of other crops, as, for example, in the ear-to-row plan of improving corn now so generally followed in this country. Plant breeders agree that too much stress can not be laid on the importance of searching for the exceptional individuals that may have great potential value for crop improvement. The best varieties of all our cultivated crops whose history is known came originally from a single plant or tree of unusual merit discovered by some observing grower.

Beginning the selection.—The first essential for selection is the formulation of the ideal type, toward which all subsequent work should be directed. It is assumed that the farmer who desires to improve his cotton has already planted a field from the best obtainable seed and has pulled out all objectionable hybrid or run-out stalks. He should begin to make selections as soon as the first bolls open. Choose the plants having a long staple and in other respects conforming to the ideals described. Mark these plants with a white cloth and a tag bearing a number. It is advisable also to set a tall stake by each selected plant, so that it can be found more readily. Pick each separately and at the end of the season spread on a table and compare the various lots critically and at leisure with regard both for length and fineness of staple and for yield. Discard the inferior ones until from 10 to 25 are left. These are to be further tested by planting the second year to discover the prepotency or transmitting power of each.

Second year: The progeny test.—Plant the seeds from the selected plants in adjoining rows, keeping each lot separate. These small

lots can be planted in the lint, provided care is taken not to cover them very deep. Select ground adapted to cotton and have it well prepared. Plant with care, dropping only two seeds to the hill, and later thin to one plant. If possible, have 100 hills to the row. The location should be as far from other cotton as possible, to lessen the crossing. Isolation can usually be secured by planting the seed plat in the section of the farm used that year for other crops—in the middle of a cornfield, for instance. If it is necessary to plant near other cotton, plant a wide border of the same variety around the breeding plat. By all means avoid proximity to Upland cotton, which is the most serious factor in the deterioration of Sea Island cotton.

The object of this planting is to determine the relative merit of the different selections, and particularly their uniformity. The general excellence of the plants in each row should be considered—

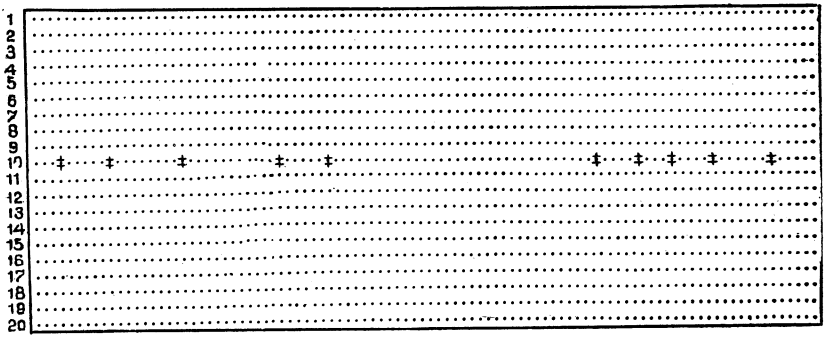

FIG. 7.—Diagram of pedigree breeding plats.

their vigor, productiveness, and freedom from disease. Any row lacking uniformity to a marked degree should be eliminated from consideration. When the bolls open, compare the staple, length, fineness, and uniformity, and finally choose the row possessing the greatest merit. This is to be the beginning of the new strain. In this row mark and pick separately the best 10 plants. (Fig. 7.) Pick together the remaining plants in the row. The other rows in the plat, although not retained for breeding, will be better than unselected seed and may be used for planting the general crop.

The desirability of this method of breeding will not be appreciated until it has been tried and the variations in the offspring of different plants observed. It is common to find one row with plants all alike possessing a staple longer than the average and also more productive, while another row may be widely variable in form of plant and quality of staple. Plants of superior merit often appear in the variable rows. They should not be saved, however, as the chances are that their offspring will be variable like the row in which they appear.

Third year: The increase plat.—The seed from the best row of the second year is to be planted in a small field to produce seed for planting the general crop. Any inferior plants that chance to appear in this field should be destroyed, but no other selection need be practiced, as it is not intended to plant this strain permanently, but to renew the seed annually from a new increase plat.

In addition to the increase plat, the progeny test is to be repeated, using the 10 plants chosen from the best row. Selections of exceptional merit that may be discovered in the general field should be tested in an isolated progeny plat, to avoid crossing with the select strain. Select in the same manner as before the best row and the best plants therein.

Fourth year: The general crop.—In this year and each succeeding year the same process of selection is carried out. This should become a part of the regular farm practice, to be considered of equal importance with cultivating and fertilizing. The several stages under way from now on are as follows:

(1) Selection of the finest plants.
(2) Progeny row test to determine transmitting power, uniformity, and productiveness.
(3) Increase plat.
(4) General crop.

If seed from the general crop is to be sold, careful attention must be paid to removing tall hybrid or run-out stalks from the field whenever they are observed. Seed from the last picking had better be rejected, as the upper bolls do not mature their seed as well as the lower ones.

Separate ginning of the seed crop important.—Cotton from the breeding plats or from other fields intended for seed should be ginned separately and the gin and conveyors first thoroughly cleaned of foreign seed. The farmer should personally superintend the ginning of his selected seed, as a mistake at this stage might lose him the fruits of several years' work. Owners of ginneries should realize their opportunities and obligations in this direction and afford their patrons every facility for the separate ginning of selected seed cotton.

The sale of cotton in the seed is a hindrance to seed improvement unless there is at the same time an organized movement for the distribution or sale of improved seed to the farmers.

IMPROVEMENT OF COTTON SEED BY GRAVITY SEPARATION.

It has been found possible to secure a marked gain in the percentage of germination and the vigor and productiveness of the cotton crop by removing the light-weight and imperfect seed before planting. For example, in an experiment by the writer the heavy seed germinated 27 per cent better than unselected seed and 42 per cent better than light seed thrown out by an air blast.

The separation is effected by means of an air blast produced by a fanning mill modified for the purpose. All who handle considerable quantities of Sea Island cotton seed will find it profitable to use such an apparatus. Seed from which the unginned locks and tufted seeds have thus been removed is much better adapted for use in cotton planters. Another very important gain in this process is the removal of the fuzzy seeds of Upland hybrids, which on account of their greater surface are blown out with the light seed. All ginneries should be equipped to treat in this way seed intended for planting.

IDEAL QUALITIES OF SEA ISLAND COTTON.

LENGTH OF STAPLE.

In Georgia and Florida the breeder should work for a staple not less than $1\frac{5}{8}$ inches or more than $1\frac{3}{4}$ inches in length. In South Carolina each planter is guided by his own preferences, some planters choosing the medium kinds on account of their greater productiveness and others finding it profitable to grow the extra fine and long varieties. Experience has shown, however, that these fine strains, having a staple 2 inches to $2\frac{1}{2}$ inches long and selling from the Sea Islands at 40 to 60 cents per pound, are not profitable in the interior. As compared with the medium sorts, they are less productive and more subject to disease, while the bolls are smaller and the cotton harder to pick. The fine staple requires more care in handling than the interior farmers are accustomed to give, and the interior markets will not pay as high prices as Charleston. In the past the best results in the interior have been obtained with strains classed on the Sea Islands as medium fine, such as Hinson and Seabrook.

To determine the length of staple from a sample of seed cotton, pull a lock apart and take a single seed and carefully straighten out the fibers with the fingers or a fine comb. Measure the length of the greatest number of fibers; then test several other seeds from the same plant.

UNIFORMITY OF STAPLE.

After determining the length, estimate the amount of shorter staple in the sample and discard plants having a portion of their staple either very long or too short. Uniformity is an important quality, as the spinner can not utilize the short fibers, which are combed out as waste.

STRENGTH OF STAPLE.

Pull a tuft of fibers until it breaks. Diseased plants show a marked weakness, and some healthy ones produce a weak staple and should be discarded.

PERCENTAGE OF LINT TO SEED.

This quality, or the "ginning average," is important, but farmers often lay too much emphasis on it, forgetting that it is the total yield of lint per acre that determines their profit.

The percentage of lint should be determined by ginning and weighing both lint and seed. The result is usually expressed in terms of the amount of seed cotton required to produce 1 pound of lint. To determine this, divide the weight of seed cotton by the weight of lint. To express the same in a percentage, divide the weight of lint by the weight of seed cotton. Having the ginning rate, to reduce it to a percentage basis, divide 1 by it; for example, 3.33=30 per cent. The percentage of lint varies considerably in different varieties of cotton, from 25 per cent, or 1 to 4, in extra-fine Sea Island cottons to 39 per cent, or 1 to 2.56, in small-seeded Upland cotton. It varies among plants in the same field, and there is a marked variation in different seasons, the percentage of lint being higher in favorable seasons. Even with the same variety and the same season, differences in soil and culture influence the percentage of lint. For example, a consignment of Seabrook seed was divided among several farmers in 1904. The ginning rates of the different crops produced from this seed varied from 3.96, or 25 per cent, to 3.10, or 32 per cent, the average of 41 fields being 3.42, or 29 per cent.

COLOR OF STAPLE.

The staple should have a lustrous creamy tint in preference to a dead white. The color should be uniform, as mixtures of white and creamy cotton are not desired by the buyers.

FINENESS.

Fineness depends on the diameter of the fibers, which can be measured exactly only with a microscope. An excellent opinion can be formed from the feeling of the cotton, if not too dry. Fineness is a very important quality to the spinner.

PRODUCTIVENESS.

Next to length of staple, productiveness is the most important quality. In making selections a preliminary estimate can be made by the eye or by counting the bolls. Sea Island planters estimate that every 15 bolls per plant equals 100 pounds of lint per acre under ordinary conditions. In breeding, the principal weight should be placed upon the yield from the progeny rows the second year of the selection. Strains derived from different plants in the same field have been found to vary greatly in productiveness, and careful selection will greatly improve any variety in this respect.

FORM AND SIZE OF PLANT.

The plant should be compact, 4 to 6 feet high, with a strong central stalk and two to four well-fruited basal branches. Fruiting branches should occur at close intervals, 1 to 2 inches, and a habit of double bearing, or producing an axillary branch at each node, should be

developed. All branches should be close jointed and bear a boll at every joint. (See fig. 8.)

BOLLS.

The bolls should be large, long, and well filled to the end, not tapering too abruptly. As a rule a long boll indicates a long staple and a short or obtuse boll a shorter staple. The number of locks should be four. The majority of Sea Island bolls have but three. More than four locks, even if obtainable, would not add to the yield or to the convenience of picking. The bolls should open well, as such bolls ripen their cotton better and are far easier to pick. In making selections do not choose wide-opening bolls without examining the staple, as a wide-opening boll is usually correlated with short staples. In respect to this character and to the number of locks, care should be taken to avoid plants resulting from chance crossing with Upland cotton. If the size of the involucre, or "square," could be reduced by breeding, there would be less trouble from bits of dry leaf in the cotton at picking time.

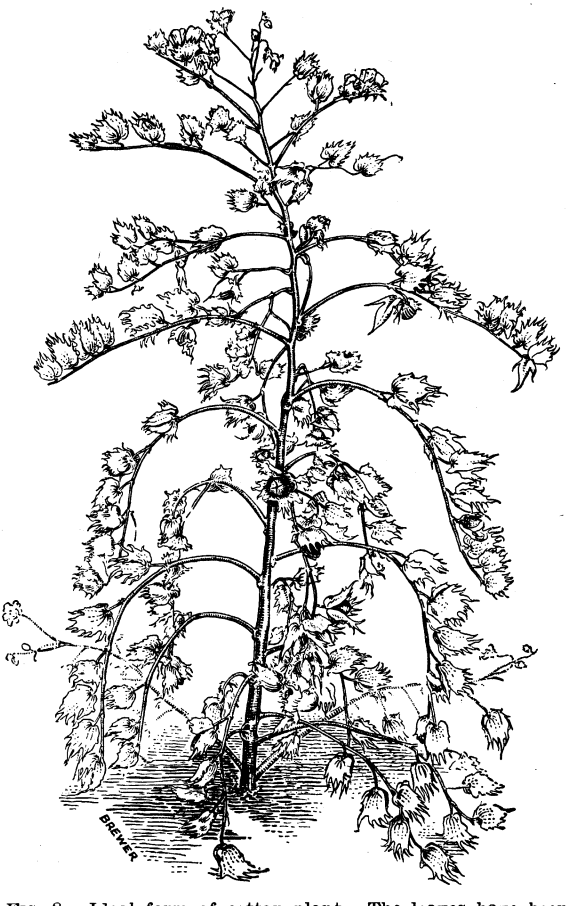

FIG. 8.—Ideal form of cotton plant. The leaves have been removed in order to show branching.

SEED.

The seed should be small, but well filled, black, with a small green tuft at the end. A large, perfectly bare seed is correlated with a low ginning rate and a large, coarse plant, and is usually taken as an indication that the strain is running out. An excess of short fuzz is

characteristic of some Sea Island varieties, but such cotton can not be ginned as rapidly as other kinds. Large seeds entirely covered with white or green fuzz indicate hybridization with Upland cotton, but occasionally occur in pure Sea Island cotton.

EARLINESS.

Very early varieties are usually less productive than later ones, while very late ones may be caught by frost before fully mature. As the boll weevil invades the Sea Island districts, the breeding of early varieties apparently will become an important phase of the struggle for the preservation of this industry. Much earlier strains can be produced by skillful selection.

DISEASE RESISTANCE.

In some instances disease resistance may be a feature of fundamental importance, as when the land is infected with wilt. In such cases one of the disease-resistant varieties described on page 37 should be planted. In all selections attention should be paid to this point, particularly to secure resistance to black-arm and to anthracnose of the bolls.

HANDLING THE CROP.

PRESERVING THE FULL VALUE OF THE CROP.

After devoting his best energies for a whole season to the production of a fine crop of cotton, the farmer must still continue his vigilant oversight until the staple has left his hands. Sea Island cotton is a fine and delicate product, and there are many ways in which it may be injured and its value reduced. All defects in the cotton are ultimately charged to the farmer's account and reduce the price paid to him. If the spinner finds in a lot of Sea Island cotton 10 per cent more waste than in Egyptian cotton available for the same purpose, he will manifestly be unable to pay as much by 10 per cent for the Sea Island. By a little care much of the present waste can be avoided; hence, strict attention should be paid to these factors.

GRADE: DEFINITION AND IMPORTANCE.

In the cotton market the term "staple" refers to the length and fineness of the fiber, and these points are influenced most by seed selection. The term "grade," on the other hand, indicates the appearance of the cotton as regards cleanliness and color, qualities influenced mainly by the manner in which the cotton has been handled. The price is considerably influenced by the grade.

DEFECTS INFLUENCING GRADE.

(1) *Loss of bloom or luster.*—The best Sea Island staple has a gloss or luster which adds greatly to its beauty and is indispensable for certain kinds of fabrics. This bloom is destroyed by exposure to

sun and storm when cotton is left long unpicked, and the staple then has a gray, lifeless appearance, sometimes termed "mildewed" or "weather beaten." A similar effect is produced by picking cotton when wet with rain or dew and storing it in piles without first drying it in the sun.

To preserve the staple at its best, pick often—once a week, if possible—and expose the seed cotton to the sun to dry. This is done by spreading it in a shallow layer on a low roof or arbor, where it is turned frequently until so dry that the seed will crack between the teeth.

(2) *Loss of strength.*—The loss of luster is accompanied by a lessened strength, so that a staple originally good fails to make as strong thread as before—an added reason for better care. Very dry cotton is also not so strong as that which, under proper treatment, has retained its natural moisture.

(3) *Neps.*—The small matted knots which occur in cotton are designated as "neps" by spinners. They are difficult to remove in the process of spinning and often go into the thread and appear in the completed fabric as white dots. These neps are in reality tangles in the fibers, which when viewed under a microscope are seen to be weak and undeveloped. They are due in part to picking cotton before maturity; a boll that is forced open to extract the lint is a source of nep, as the cotton in it does not get the necessary exposure to the sun to dry and straighten and strengthen the fiber. Other nep originates with weak cotton from diseased bolls or from any other cause that prevents the fibers from attaining full development. Such undeveloped staple comes from the gin full of nep. Poor ginning, however, by weakening and breaking fibers increases the loss from this cause. Pickers should be cautioned against picking unripe bolls. Thorough sunning will in part remedy the trouble, and good culture, by producing healthy plants, will do more.

(4) *Broken leaves, etc.*—The presence of fragments of leaves, weed seeds, and other foreign matter in the cotton reduces its grade. These are often difficult to avoid, particularly after storms, when bits of the dried square, or involucre, are often mingled with the cotton; but pickers should be watched and cautioned against picking dirty cotton. Fortunately, the spinners find it easier to remove this class of impurities than the nep previously mentioned.

(5) *Short fibers.*—A large part of the waste is due to short fibers, which have to be combed out. They originate in part in variations in the length of the staple on the seed, a serious fault, to be remedied by seed selection, as discussed under uniformity (page 25). Short fibers are in other cases due to imperfect ginning, which breaks or crimps the staple and may be avoided by better adjustment of the gin.

(6) *Weak fibers.*—The greater part of the waste is due to the presence in the baled cotton of staple from undeveloped or diseased bolls. The bolls in such cases do not open, and the fibers do not expand but remain matted together in a "hard lock" (fig. 9). All locks that do not open out after drying may be assumed to be worthless on account of weak and undeveloped staple. Pickers should be instructed not to gather hard locks, and in the assorting after picking all remaining ones should be thrown out. Seed cotton still containing hard locks when it reaches the gin can be improved by setting the stripper bars well back from the roller to allow the locks to fall through. Close ginning is a mistake, for it costs the farmer more through deterioration of his cotton than he gains by the slight increase in weight.

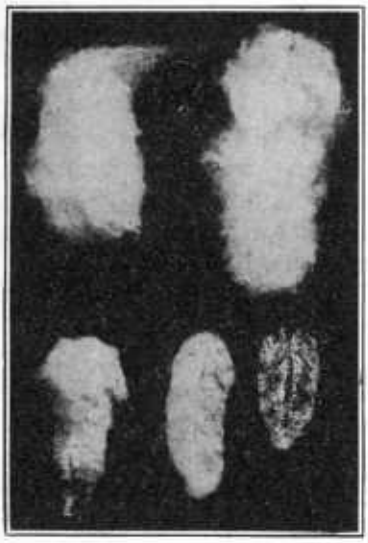

FIG. 9.—Locks of Sea Island cotton from healthy bolls (at the top) compared with hard locks from diseased bolls (below).

The number of hard locks can be greatly reduced by bringing the cotton to perfect maturity through attention to fertilization and culture and to the control of diseases.

(7) *Lack of uniformity in the bale.*—Separate late from early pickings. Buyers desire to have each bale uniform within itself. If, therefore, a late picking is inferior to an earlier one, it should not be ginned and packed with it, as the price of a bale is determined by the poorest cotton found in it after thorough sampling.

(8) *Yellow cotton.*—Buyers invariably complain when a sample of cotton contains yellow staple, and the grade and price are consequently reduced. Yellow tufts in the ginned cotton come from discolored locks that should have been left unpicked or sorted out before ginning. They originate, as a rule, in bolls attacked by the anthracnose or bacterial boll-rot (see page 39). Their presence in a bale is an indication of too close ginning.

(9) *Sand.*—A bale of cotton always contains considerable sand which has been blown into the open bolls. This is quite unavoidable, but when cotton has been left unpicked and has blown out on the ground the quantity of dirt is increased.

(10) *Moisture.*—An element of waste from the spinner's standpoint is the moisture which evaporates during the process of manufacture. This moisture may be excessive in cotton picked early in the season and ginned without drying. There may, on the other

hand, be a lack of moisture. The cotton may be overdry and appear harsh and brittle. Such cotton gives trouble in spinning because of the electric current it develops.

The question of moisture is one of the most important connected with the handling of cotton. Either an excess of moisture or a lack of it reduces the grade. The farmer must never add water to the cotton, but he should seek to retain the optimum amount of natural moisture. This means that to drive off excessive moisture freshly picked cotton should be sunned until the seeds will crack in the teeth. The staple will then be slightly overdry and unfit to gin or offer to the buyer. To restore its grade it should be "bulked." Bulking, as practiced on the Sea Islands, consists in placing the seed cotton, after sunning, in a large, deep, square pile in a cool room. It should be packed down solidly and, if the air is dry, covered with blankets or boards and left from three to six weeks before ginning. When it comes out of bulk the staple has lost its harsh feeling and is soft, oily, and glossy.

Care must be taken never to bulk cotton that has not previously been well dried, or the pile will heat. On the other hand, a loose, conical pile, formed by throwing seed cotton into a storeroom, is not a bulk, for it does not prevent the cotton from drying out still more. As a rule, cotton brought to the gins early in the season is too green and damp and needs sunning to put it into good condition, while that coming in late or taken from the storehouses during the winter is overdry and consequently harsh and brittle. Both the lint cotton and the thread spun from it lack their full strength if too dry. Everyone knows how a dry twig will snap in the fingers, while a green one only bends. The same to a less degree is true of the cotton fiber. The quality is best maintained, however, by avoiding overdrying rather than by the addition of moisture.

(11) *Injury in ginning.*—The grade of cotton is often reduced during the process of ginning. This may be the fault of the farmer, as when he brings his cotton to the gin damp or full of hard or yellow locks or broken leaves and insists on close ginning; or the fault may lie with the ginner, who has failed to adjust his machines so that no seed can be broken. Briefly stated, seed cotton must be dry; if green or wet, "crimping" invariably results, to the serious injury of the fiber. The seed cotton should be free from hard locks or else the stripper bar should be adjusted to let them fall through with the seed. Close ginning is a form of adulteration instantly detected by the buyer and very costly to the farmer. The modern fruit grower has learned that he can not profitably mix his culls with his first-grade fruit, and the cotton grower must come to a similar conclusion.

The most frequent defects due to ginning are the presence of portions of broken seed and the cutting or crimping of the fiber. Since

poor ginning costs the farmer, at a conservative estimate, 1 cent a pound, the ginner should be required to maintain his gin in perfect adjustment and to gin the cotton free from cracked, clipped, mashed, or whole seed and free from crimp.

The ginned cotton should come from the roller steadily and in an unbroken flake. Whenever it does not do this, an examination will show that the adjustment is not perfect, and the cotton is liable to sustain injury unless the trouble is corrected.

SUMMARY.

The best practice in handling the crop may be briefly stated by describing the method followed on the Sea Islands, which should be adopted in the interior in so far as the labor conditions will permit.

Picking is done whenever enough cotton is open, about every 10 days. The cotton is gathered as free from trash as possible and carried to the storehouse, where the next morning each picker sorts his own picking, throwing out diseased or yellow locks and pieces of bolls, leaves, and other trash. The cotton is then spread on arbors to dry in the sun. It is watched and turned frequently, and usually dries in one day. After sunning, the seed cotton is assorted by women, who remove any yellow locks, bits of leaves, etc. If very dirty it is whipped over a coarse wire screen stretched across a small box to take out the sand. Very fine cotton is again sorted or overhauled by another set of laborers. The cotton is then bulked and allowed to remain from four to six weeks before ginning. During the ginning, one or two hands inspect the cotton as it passes to the gins, to remove impurities, and one of two others "mote" the lint as it passes from the gin to the press, by picking out yellow tufts, etc. By all these means a high grade is maintained for Sea Island cotton, which is reflected in a price per pound several cents higher than that paid for interior cotton.

DISEASES OF SEA ISLAND COTTON.

SORE-SHIN AND DAMPING-OFF.

Cotton seedlings sometimes become diseased shortly after coming up, particularly when soil or weather conditions are unfavorable. The term "sore-shin" is applicable to diseased spots or cankers formed on the stem or root of the seedling. These spots result in a reduction of growth, in yellow leaves, and, if they encircle the stem, in the death of the plant.

A fungus (Rhizoctonia) is usually held responsible for the trouble, but it is only after cold and wet weather has checked growth and weakened the plants that serious loss results. If warm and favorable weather prevails, the cotton soon outgrows the disease. No direct remedial measures are practicable. The danger of loss can be

minimized by thorough preparation of the land before planting, by draining lower lying fields, and by thick seeding. Broken stands must be filled by replanting.

Damping-off, or the collapse of the stem at the surface of the ground, may be due to the sore-shin fungus or to other parasites. It is often caused by anthracnose, in which case the seed was probably infected before planting. The recommendations for the treatment of anthracnose on page 39 apply also to this form of it.

BACTERIAL BLIGHT.

There is a bacterial disease of cotton (*Bacterium malvacearum* Erw. Sm.) which is found to occur on different parts of the plant, producing various symptoms and receiving various names, such as angular leaf-spot, black-arm, boll-spot, etc., according to the point of attack. We describe all these together.

The earliest appearance of the disease is perhaps on the leaves, where it produces what is commonly known as the angular leaf-spot. These spots are at first a water-soaked green, becoming black when older. They are angular in outline, one-eighth to one-fourth inch in diameter. They are scattered over the leaf, but are often more numerous near the large veins. When one of these veins is attacked the disease rapidly extends its whole length.

Infection of the petiole is less common, but sometimes occurs, causing the leaf to turn yellow and fall off.

Infection of the pedicel of the bolls is a common cause of shedding and of failure to open. The bolls themselves are also attacked, the points of infection being water-soaked at first, later appearing considerably sunken and almost black. This organism does not appear to be as active a cause of boll-rot as the anthracnose fungus and several bacteria which appear to follow it, and which very likely gain entrance through the bacterial spot.

In June young plants are sometimes attacked on the main stem, near the ground or higher up, where a canker is formed which so weakens the stem that it is broken off later by winds or during cultivation. It is later in the summer that the most damage occurs, when the disease attacks the fruit-bearing limbs. The spots on the limbs are dark—nearly black—and, though not deep, so sap the vitality as to cause the shedding of all the smaller bolls. In many cases, when the season is wet, infection by anthracnose follows and adds to the injury. Several forms of the disease are illustrated in figure 10.

Egyptian cotton is peculiarly subject to this trouble—so much so that its cultivation in the Southeastern States appears to be impracticable. There is considerable variation in the resistance of different races of Sea Island cotton, Rivers, for instance, being rather susceptible, while Centerville is nearly immune.

Remedial measures must be indirect. Resistant varieties can be developed by selection. Diversification and rotation of crops will tend to reduce the amount of infectious material remaining on the land and will lessen the disease. Black-arm is probably carried

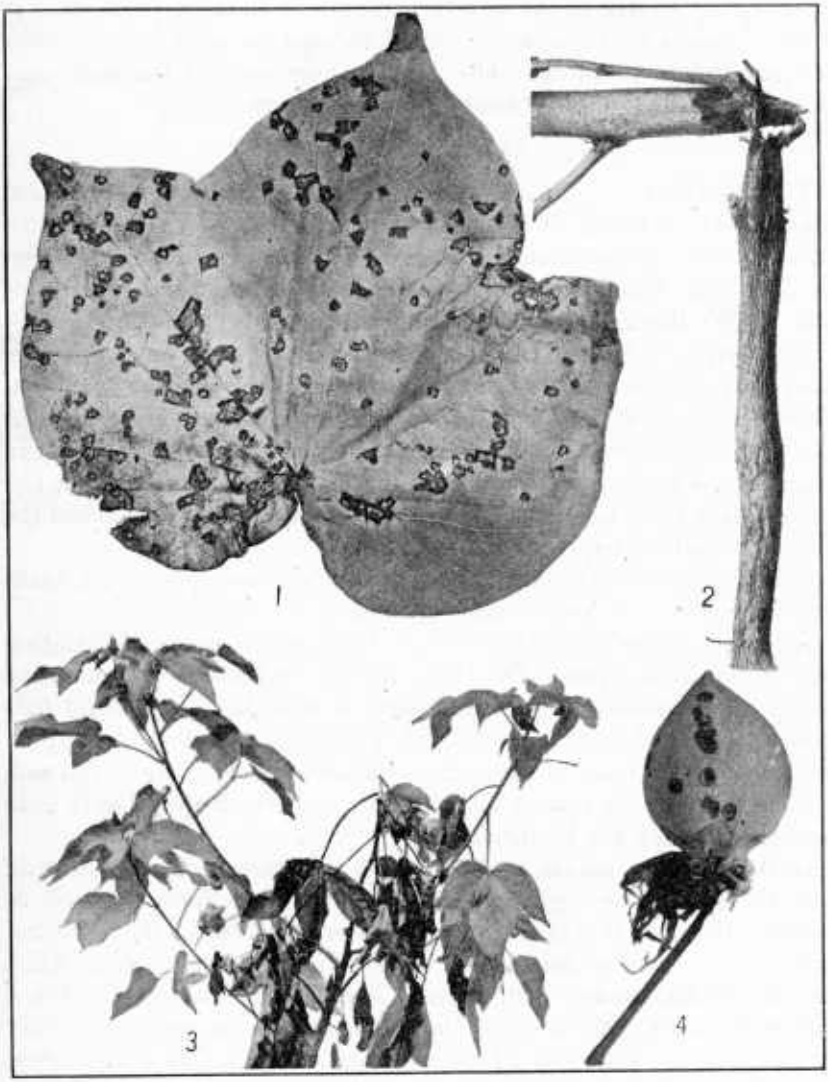

FIG. 10.—Diseased leaves, boll, and stems of cotton plants, showing several forms of bacterial blight: 1, Angular leaf-spot (Upland cotton); 2, black-arm (Egyptian cotton); 3, stem canker on a young Sea Island plant: 4, bacterial boll-rot (Upland cotton).

through seed to some extent, and the selection of seed only from healthy bolls will greatly aid in its control. It may be expected that a reduction of the nitrogen and an increase in the amount of potash in the fertilizer, by inducing development of less succulent branches, will reduce the danger of infection.

WILT.[1]

Cotton wilt, often called black-root, is one of the most serious diseases of the crop wherever it occurs. It is characterized by the death of the plants in gradually enlarging spots in the field, where the disease reappears year after year. The plants are attacked at any time after they are a month old, but die fastest in June and July. The affected plants wilt, or a few leaves at a time turn yellow between the veins and fall off. (Fig. 11.) When the stem or root is cut the woody portion is found to be brown or black. This discoloration is one of the most characteristic symptoms of the disease and has given it the name black-root.

FIG. 11.—A healthy cotton plant and one affected with wilt.

Wilt is most prevalent on the sandy or sandy loam soils best suited for Sea Island cotton. Low spots and rich bottom lands often escape the disease long after the cotton on the higher portions of the field is killed. Clay soils are, as a rule, free from it. Geographically, wilt occurs more or less in all the Sea Island cotton-growing districts, both in South Carolina and in the interior. It is also serious in Upland cotton fields from North Carolina to Texas.

CAUSE.

Wilt is due to a fungus (*Fusarium vasinfectum* Atk.) which enters the small roots from the soil, grows into the water-carrying vessels of the root and stem, and fills them, thus shutting off the water supply of the plant.

[1] See also Gilbert, W. W., Cotton wilt and root-knot, U. S. Dept. Agr., Farmers' Bul. 625, 21 p., 15 fig. 1914.

This fungus spreads by direct growth through the soil and also forms three kinds of spores, viz, one in the interior of the stem, another in cushions on the outside of dead plants, and a third in the soil or on the surface of the plant. This fungus is without doubt spread to some extent by the feet of stock passing through the fields, carried in drainage water from high to low land, and distributed by plows and cultivators. When it appears in a field, attempts to restrict its spread are useless, so far as the writer's knowledge goes. As wilt attacks only cotton and okra, good yields of corn and other crops can be obtained on infected land. A long period of rotation tends to diminish the amount of disease, but the fungus can live in the soil for several years, cases being on record where seven years' rest failed to free the land from wilt.

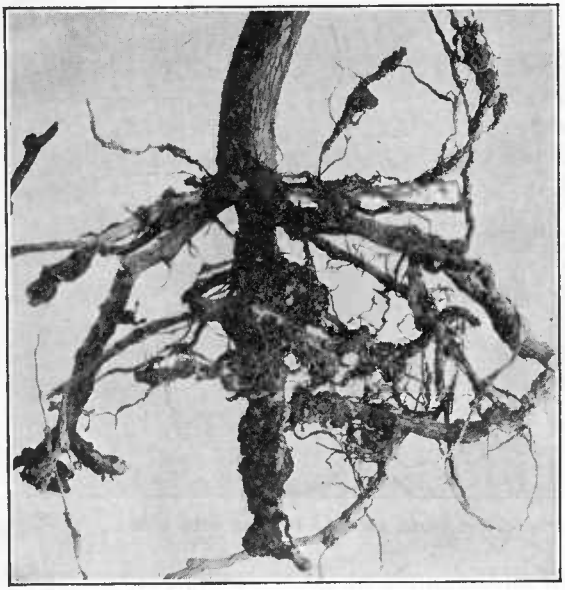

FIG. 12.—Root-knot on a cotton plant grown on land where nonresistant cowpeas were raised the previous year.

An important point in connection with the question of rotation is the danger from root-knot, another disease, described on page 38, which often occurs along with the wilt.

Enlargements of the roots of cotton (fig. 12) indicate that root-knot is present and that a rotation of crops must be practiced to control it. The combined treatment of wilt and root-knot is based on the following principles:

(1) Cotton wilt attacks only cotton and okra. It does not disappear after rest or rotation. Resistant varieties can be secured.

(2) Root-knot attacks cotton, cowpeas, sweet potatoes, vetch, melons, and many other crops, but does not attack corn, oats, velvet beans, or the common grasses. It diminishes and finally disappears when all susceptible plants are kept off the field, and in ordinary farm practice can be held in check by a suitable rotation of crops. No variety of cotton is wholly resistant to root-knot.

A rotation similar to the following should therefore be adopted: First year, corn with Iron or other resistant cowpeas, or peanuts; second year, winter oats, or, if preferred, rye or wheat cut early for

hay and followed at once with velvet beans; third year, cotton of a wilt-resistant variety.

SOIL TREATMENT NOT A SUCCESSFUL REMEDY.

It has been found impossible to kill out the fungus in the soil by any treatment with fungicides. Experiments have been made with lime, sulphur, copper sulphate, formalin, carbolic acid, and numerous other substances, none of which had any effect in reducing the amount of wilt.

The fungus is so spread through the soil that it is unlikely that it can ever be killed by any treatment that would be cheap enough to be practicable.

THE RELATION OF SOIL CONDITIONS TO WILT.

It should be emphasized that wilt is due to the presence of a parasitic fungus, not to any unfavorable soil conditions. The fungus is, therefore, to be looked on as a weed, and the disease may be expected to appear wherever its spores are carried. There are no chemical or physical differences between wilt-infected and healthy soils of the same type. Wilt is not due to the continual use of commercial fertilizers nor to the exhaustion of any element of plant food. Its preference for light and sandy soils has already been noted. Our experiments indicate that the free use of stable manure will assist in the control of wilt by increasing the vigor of resistant varieties, but the ordinary nonresistant kinds are not sufficiently protected by stable manure. In the same way other organic fertilizers, such as compost and leguminous crops plowed under, will effect an improvement of the crop.

CONTROL THROUGH THE USE OF RESISTANT VARIETIES.

It has been found possible to secure by seed selection varieties of Sea Island cotton resistant to wilt which will yield full crops of good quality on badly infected land, provided there is not too much root-knot present also. They were developed on the Sea Islands by selecting seed from exceptional plants that withstood the disease and remained healthy in the most infected spots. The first and best of these varieties is the Rivers, bred by Mr. E. L. Rivers, of James Island, S. C., in connection with the experiments of the United States Department of Agriculture. The Rivers cotton is productive, vigorous, compact, branching low, and with small, close-jointed limbs, often double bearing; bolls medium size, three to four locks; seed small, black, with a small green tuft; average percentage of lint to seed 28, giving a ginning rate of 3.57; staple fully to extra fine, and when grown on the Sea Islands 2 inches long.

The Rivers cotton is an excellent variety for the Sea Islands and for the best localities in the interior, but has too long a staple to be adapted to interior requirements, although its total yield per acre compares favorably with any other. It has also shown some susceptibility to black-arm when cultivated in Georgia.

Other resistant strains have been developed by the South Carolina Sea Island growers, and very little loss from wilt now occurs there.

Farmers who have wilt-infected land should secure seed of a resistant variety or, failing in this, should plant some other crop than cotton on the disease-infected field.

Once a wilt-resistant variety is obtained, this quality of resistance should be maintained by the method of selection already described. Dependence can no longer be placed on the hope of obtaining seed from outside growers.

CONTROL THROUGH ORIGINATING NEW VARIETIES.

Anyone who will give the necessary time and care can develop new resistant strains from the resistant plants that occasionally appear in fields of ordinary cotton. He must be prepared, however, to continue the breeding for several years before the desired results are attained.

No one should gather seed promiscuously from an infected field with the idea of gradually developing a resistant variety, for such methods are costly and usually fail. Breed from individual plants instead.

ROOT-KNOT.

Root-knot is a common and widely distributed disease in sandy soils throughout the southern tier of States. The effect on the plant is to lessen its vigor and dwarf its size. The seat of the trouble is at the root, which becomes distorted and covered with small swellings or knots. (See fig. 12.) These are produced by a minute nematode worm (*Heterodera radicicola* [Greef.] Mül.) which penetrates the roots and lives within them. On breaking open a large knot, one can often detect minute pearllike bodies, which are the female worms distended by masses of eggs.

Root-knot is a more serious enemy of peaches, vegetables, tobacco, and cowpeas than of cotton. It becomes of great importance to the cotton planter when it occurs in connection with wilt, which it very often does, as the loss from cotton wilt is much increased by the root-knot complication. The treatment required is the rotation of crops that has already been discussed under wilt. The subject is treated more fully in Farmers' Bulletin 648.[1]

[1] Bessey, E. A., and Byars, L. P. The control of root-knot. U. S. Dept. Agr., Farmers' Bul. 648, 19 p., 20 fig. 1915.

ANTHRACNOSE.[1]

The greater part of the loss from the rotting of bolls is due to the disease known as anthracnose. This occurs as dark-colored spots on the bolls, which as they enlarge become depressed and gray or pink in the center. (Fig. 13.) The seed cotton in the bolls is discolored and spoiled. The cause is a parasitic fungus (*Colletotrichum gossypii* Swth.) which is very common throughout the cotton belt. While most of the injury is done to the bolls, the fungus can attack any other part of the plant. The disease is worse in wet seasons than in dry ones.

REMEDIES.

No treatment of fields affected with anthracnose is practicable on account of the expense involved, but there are important preventive measures that will enable one to grow a healthy crop.

(1) Plant healthy seed. Where trouble from this disease is experienced, the seed for the next crop must be selected with care from perfectly healthy bolls. If a boll has one lock affected, there is danger that the fungus has penetrated all the seed. Avoid, if possible, running the selected seed cotton through a gin that has just been handling diseased cotton. All accessible parts of the machine should be wiped clean, to prevent the fungus spores from remaining to infect the selected seeds. It will not do as well to send away for seed from a healthy field, for the disease occurs everywhere. Seed 3 years old will also be safe to plant, as the fungus in it will then be dead.

FIG. 13.—A cotton boll affected with anthracnose.

(2) Plant on land that was not in cotton the year before. Twelve months' rotation will rid the soil of infection.

RUST.

The disease commonly known as cotton rust is not primarily a fungous disease, but is caused by unfavorable soil conditions. Sea Island cotton fields affected by rust take on a reddish color, the leaves drop off, sometimes leaving the stalk bare, and the upper bolls fail to open. The cotton from such rusted plants is very weak and inferior. Rust is likely to develop in definite spots in a field, and unless a remedy is applied will appear year after year. Though other factors sometimes influence particular cases, there are three principal causes of rust in cotton, as follows:

(1) Exhaustion of the humus. Continued cultivation in cotton, by destroying the vegetable matter of the soil, is the most frequent cause of rust. The color of

[1] See also Gilbert, W. W., Cotton anthracnose and how to control it, U. S. Dept. Agr., Farmers' Bul. 555, 8 p., 8 fig. 1913.

these old fields in midsummer is a lighter green, with a tinge of yellow, followed when the bolls begin to mature by the appearance of rust. A newly cleared field or an old fence row is, on the other hand, always green and free from rust. Stable manure is the most effective remedy in such cases, but a crop of velvet beans or cowpeas plowed under will effect a great improvement.

(2) Deficiency of potash. Most soils where cotton shows a tendency to rust lack potash, and an application of 200 pounds of kainit or 50 pounds of muriate of potash per acre will prove an effective remedy. Such soils are, as a rule, also deficient in humus, and a rotation of crops is usually advisable also.

(3) Lack of drainage. Rust often develops in low, wet places in a field where the higher portions are free from it, and for the same reason heavy and continued rains in August and September may lead to the development of rust in certain fields. Drainage by ditching or by tiles will be required in extreme cases. Most of these fields, however, become stagnant because the soil has no water-absorbing capacity on account of its lack of humus. If a leguminous crop were turned under every other year or stable manure applied liberally and the land plowed deep, the soil would soon be so changed in condition that heavy rains would not injure it and rust would disappear.

BLUE COTTON.

Blue cotton is a peculiar disease which occurs to a limited extent on the Sea Islands and in Florida. It is characterized by the deep-green or bluish color of the leaves, the prostrate habit of the plant, which develops numerous lateral sprouts, and the shedding of the fruit. It is caused by some physiological or nutritional disturbance of the plant, due to soil conditions not fully understood. The use of cottonseed and other organic manures aggravates the trouble. It has been successfully remedied on the Sea Islands by the use of salt mud, by liming, and by drainage.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1916